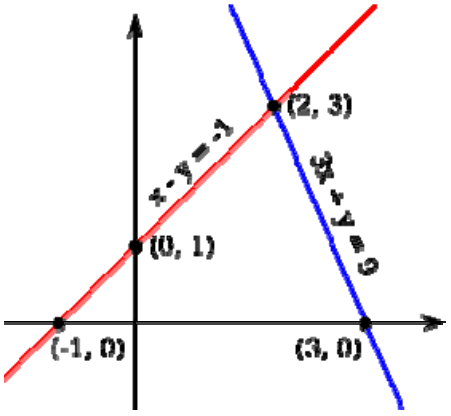
TIPS4RM

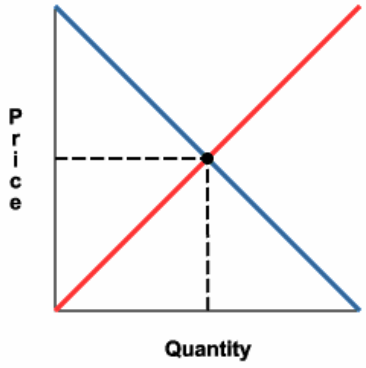
Targeted Implementation and Planning Supports for Revised Mathematics

Grades 7, 8, 9 Applied, 10 Applied

Course: Grade 10 Applied Mathematics (MFM2P)

Unit 4: Linear Systems





Dufferin-Peel Catholic District School Board

Student

REVISED

August 2008

Unit 4- Linear Systems

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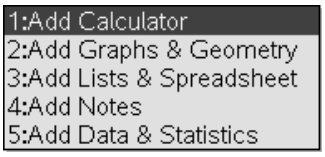
Nspire CAS Handheld Manual

Getting Started

When you turn on the handheld, press ctrl N.

You will be asked whether you want to save the document. Select **No**. To do this, use the large circular "navpad" to move to the right, then press the ⬤ button in the middle of the navpad.



Next select **1:Add Calculator**. To do this, press the ⬤ button again.

You are now ready to use CAS on the handheld.

Some Helpful Shortcuts

If you make a mistake at any point that you want to undo, press ctrl Z.

If you undo something that you want back again, press ctrl Y.

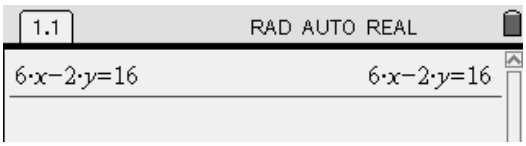
How to Solve for a Variable: Example One

Say that you wish to solve the equation 6x – 2y = 16 for the variable y.

To do this, first be certain that you are on a **Calculator** page. If you need help with this, see the Getting Started section above.

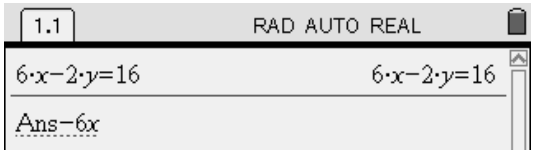
First type in the equation that you want to solve. Use the number pad and the green letter keys; the operations (÷, ×, -, +) are located on the right, and the equals sign (=) is in the top-left corner of the keypad. When you have typed in the equation, press the enter key, found in the bottom-right corner.

The top of your screen will look something like this:

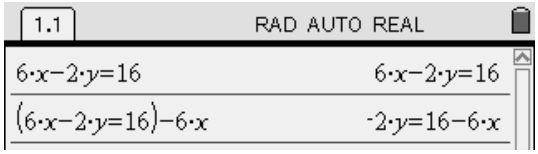


Now decide how you would start in solving for y.

Perhaps you've decided that subtracting 6x from both sides of the equation is a good start. Wonderful! To do this, immediately press ÷ 6 X. Notice that the handheld automatically inserts Ans . What is this?



Ans stands for the last answer you found. If you now press the enter key, the handheld will subtract 6x from the left side and the right side of 6x - 2y = 16. You will see this result:



Continue solving the equation. You probably see that to finally isolate the y variable, it is necessary to divide the equation by -2 on both sides. Again, just start typing the operation you want to perform. Press ÷ 2. The handheld will insert Ans for you. Press enter to calculate the result.

As you can see, the handheld reports that y = 3x - 8 .

Nspire CAS Handheld Manual (Continued)

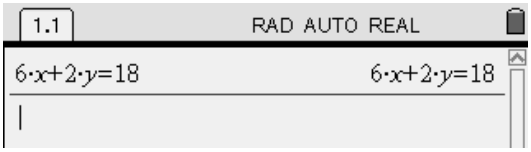
How to Solve for a Variable: Example Two

Say that you wish to solve the equation 6x + 2y = 18 for the variable y.

To do this, first be certain that you are on a **Calculator** page. If you need help with this, see the Getting Started section above.

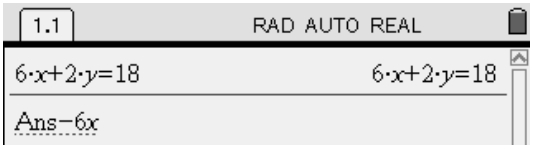
First type in the equation that you want to solve. Use the number pad and the green letter keys; the operations (÷, ×, -, +) are located on the right, and the equals sign (=) is in the top-left corner of the keypad. When you have typed in the equation, press the enter key, found in the bottom-right corner.

The top of your screen will look something like this:

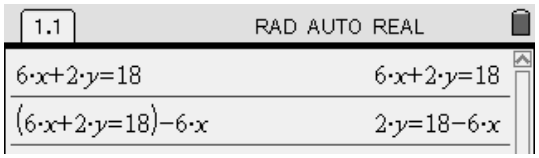


Now decide how you would start solving for y.

Perhaps you've decided that subtracting 6x from both sides of the equation is a good start. Wonderful! To do this, immediately press ÷ 6 ⊗. Notice that the handheld automatically inserts Ans . What is this?

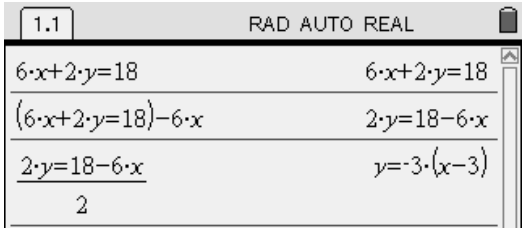


Ans stands for the last answer you found. If you now press the enter key, the handheld will subtract 6x from the left side and the right side of 6x + 2y = 18. You will see this result:



Continue solving the equation. You probably see that to finally isolate the y variable, it is necessary to divide the equation by 2 on both sides. Again, just start typing the operation you want to perform. Press ÷ 2. The handheld will insert Ans for you. Press enter to calculate the result.

As you can see, the handheld reports that y = -3(x-3) .



Is this the result you expected?

Your teacher will discuss this with your class.

After the discussion, use the space below to write your own explanation of what this means:

Nspire CAS Handheld Manual (Continued)

How to Check a Solution to a Linear System

Say that you have solved the following linear system:

$4x + 2y = 24$

$8x - 6y = 18$

and you believe the solution is $\left(\frac{9}{2}, 3\right)$.

This would be tedious to check by pencil and paper, but it is quick to check with the handheld.

Here is how to do it. First be certain that you are on a **Calculator** page. If you need help with this, see the Getting Started section from earlier in this manual.

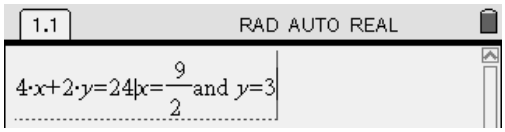
You are going to press the following keys to check the solution against the first equation:

4 X ctrl + 2 Y = 2 4 | X = 9 ÷ 2 ␣ A N D ␣ Y = 3

This means: "Check **this** equation **such that** $x = \frac{9}{2}$ and $y = 3$."

Don't forget to press the ␣ key (lower-right corner of keypad) before and after the AND.

Here is what it will look like on your handheld screen:

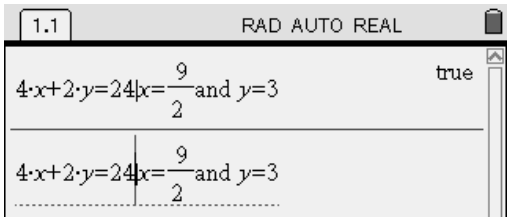


To have the handheld check the solution, press the enter key. If the solution is correct, the handheld will return the result "true". If the solution is not correct, the handheld will report "false".

You should find that the handheld reports that $\left(\frac{9}{2}, 3\right)$ is a correct solution for the first equation.

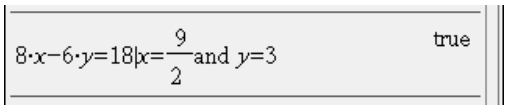
Remember, it is necessary to check the solution in the second equation as well.

It works the same way as before, but you can save some typing! Use the circular "navpad" and press **up** twice. The first command you entered is highlighted. Now press the enter key. The handheld copies the command down to the line you are working on. You can now use the navpad to move **left** until the cursor is behind the | symbol. It looks like this:



Press the clear key to erase the first equation, then type the second equation. Then press enter.

As you can see, $\left(\frac{9}{2}, 3\right)$ is a correct solution for the second equation as well.



Since the solution is correct for **both** equations from the linear system, we know it must be the right answer.

Nspire CAS Handheld Manual (Continued)

How to Add or Subtract Two Equations

The elimination method for solving a linear system involves adding or subtracting the given equations.

Say that you are considering the following linear system:

```
3x + 2y = 16
5x - 2y = 8
```

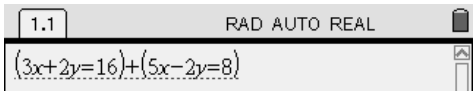
You probably agree that if we add these two equations, the y variable will be eliminated.

Here is how to do this on a handheld. First be certain that you are on a **Calculator** page. If you need help with this, see the Getting Started section from earlier in this manual.

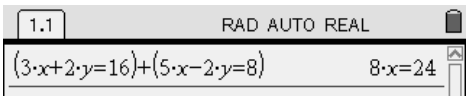
When you type in the equations, be certain to enclose them in brackets. Remember that we decided to add the equations. Here are the keys you should press:

(3 x + 2 y = 1 6) + (5 x − 2 y = 8)

It will look like this on your handheld:



Press the enter key. The handheld will display the result:



You have eliminated the y variable.

Subtracting two equations works the same way as adding two equations. The key is to remember that you must enclose each equation in brackets when you type it into the handheld.

How to Multiply to Find an Equivalent Equation

Consider the following linear system:

```
2x - 5y = 7
6x + 3y = 3
```

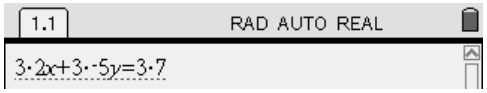
If we immediately add or subtract the equations, neither the x or the y variable is eliminated.

Instead, we must multiply one of the equations by an integer so that the coefficients match. Then, if we subtract the equations, a variable will be eliminated.

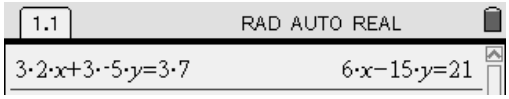
Let's multiply the first equation by 3. Remember that all terms on both sides of the equation must be multiplied by 3, so that the equation stays balanced.

Here is how to do this on a handheld. First be certain that you are on a **Calculator** page. If you need help with this, see the Getting Started section from earlier in this manual. Press the following keys: 3 × 2 x + 3 × − 5 y = 3 × 7

What you have typed should look like this:



Press the enter key. The handheld will display the result:



Now we have a system that we can begin to solve by subtracting the equations:

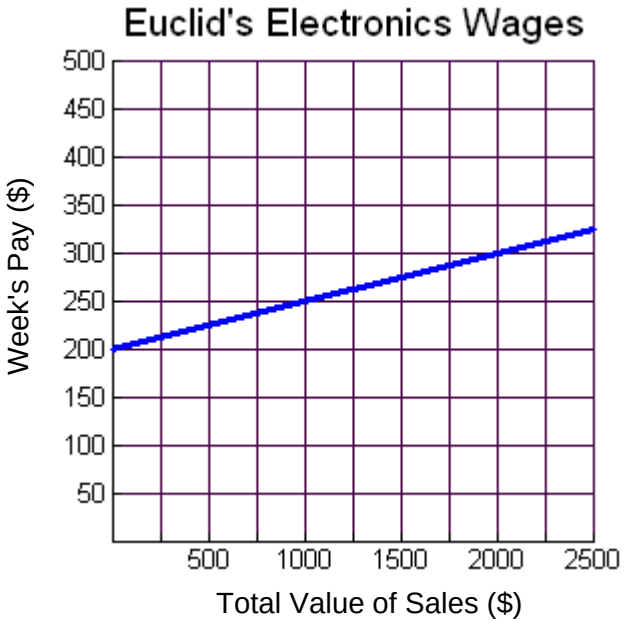
```
6x - 15y = 21
6x + 3y  = 3
```

4.1.1: Working on Commission

Nahid works at Euclid's Electronics. She is paid a salary of $200 per week plus a commission of 5% of her sales during the week.
The equation $P = 0.05s + 200$, represents Nahid's pay for the week where *P* represents the total pay for the week and *s* represents her total sales.

If Nahid earned **$290** in a week use the equation to algebraically determine how much she sold.

Use your handheld to help you solve. Refer to the user manual if you need to review how to solve using the handheld.



Nahid is offered another job at Fermat's Footwear, where the pay is a salary of $100 per week and 10% commission on all sales. The graph below represents the **Pay vs. Sales** for this job.

Which of the following equations do you think represents pay for one week at Fermat's Footwear?

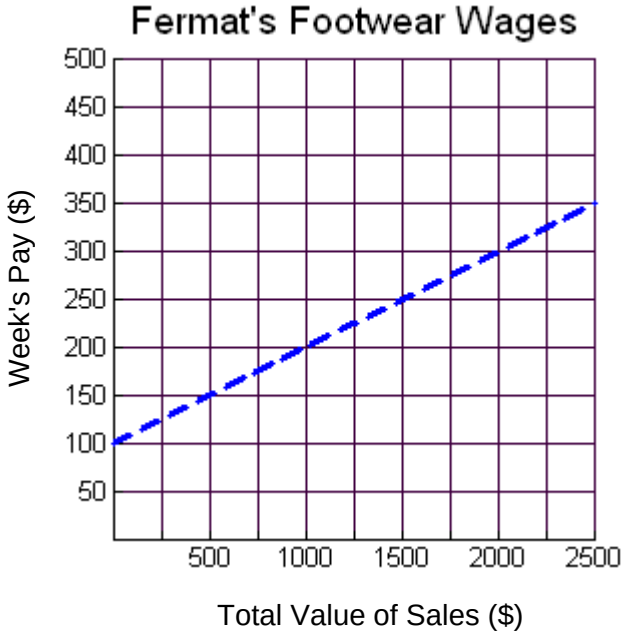
a) $P = 0.01s + 100$

b) $P = 0.10s + 100$

c) $P = 100s + 10$

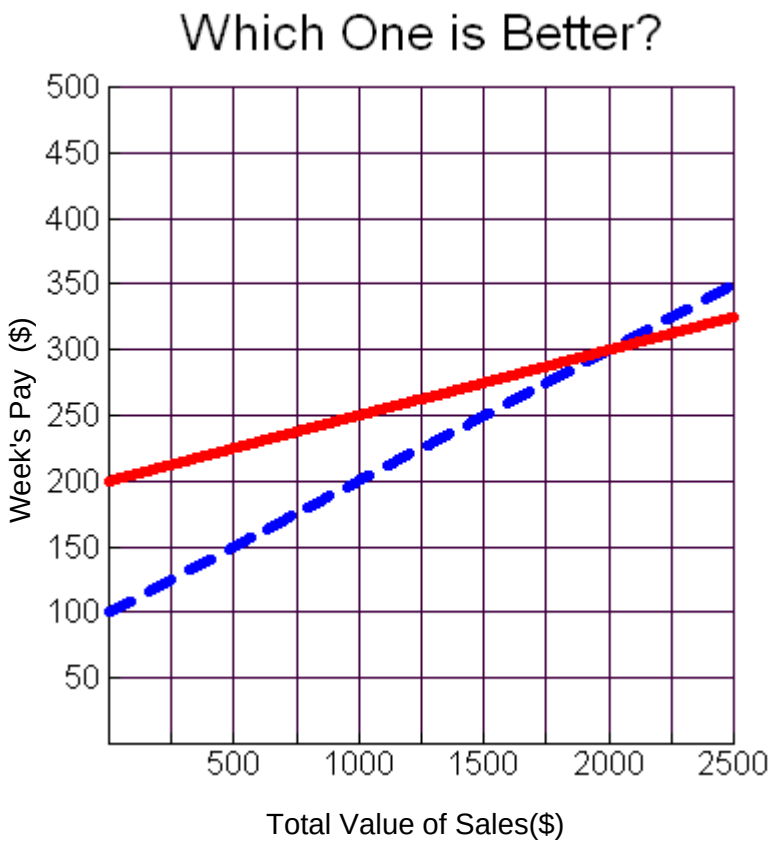
d) $P = 0.05s + 200$

Provide a reason or justify why you selected the equation that you chose. Refer back to the equation for Euclid's Electronics for hints.



4.1.1: Working on Commission (Continued)

Nahid needs help determining which job she should keep. She decides to look at them as a **system of equations** when she creates a graph comparing the two equations at the same time. Analyze the graph and complete the questions below.



_____ Euclid's Electronics

..... Fermat's Footwear

1. Where the two lines cross is called the **point on intersection**, or the **solution to the system**. At what coordinates do the two lines cross?

2. What does this coordinate represent in terms of Nahid's sales, and pay for the week?

3. If Nahid usually makes $1500 worth of sales per week, which job should she take? Explain.

4. How does the graph help Nahid determine which is the better job?

5. What does the point (1000, 250) represent in the graph?

4.1.2: What's My Equation?

You are given four problems below. Each problem will require two equations to solve it. The equations that are needed to solve each problem appear at the bottom of the handout. Match the equations with the problems and compare your answers with another student.
Note: There are more equations than problems and all the equations use *x* for the independent variable and *y* for the dependent variable.

Problem A: ***Equations***

Yasser is renting a car. Zeno Car Rental charges $45 for the rental of the car and $0.15 per kilometre driven. Erdos Car Rental charges $35 for the rental of the same car and $0.25 per kilometre driven. Which company should Yasser choose to rent the car from?

Problem B: ***Equations***

The school council is trying to determine where to hold the athletic banquet. The Algebra Ballroom charges an $800 flat fee and $60 per person. The Geometry Hall charges a $1000 flat fee and $55 per person. Which location should the school council select for the athletic banquet?

Problem C: ***Equations***

The yearbook club is considering two different companies to print the yearbook. The Descartes Publishing Company charges a flat fee of $475 plus $4.50 per book. School Memories charges a flat fee of $550 plus $4.25 per book. Which company should the yearbook club select to print this year's yearbook?

Problem D: ***Equations***

The school is putting on the play "Algebra: The Musical". Adult tickets were sold at a cost of $8 and student tickets were sold at a cost of $5. A total of 220 tickets were sold to the premiere and a total of $1460 was collected from ticket sales. How many adult and student tickets were sold to the premiere of the musical?

EQUATIONS:

1. $y = 4.50 + 475x$	2. $60 + 800x = y$	3. $y = 1000 + 55x$	4. $x = 45 + 0.15x$
5. $y = 1000x + 55$	6. $y = 45 + 0.15x$	7. $x + y = 220$	8. $5x + 8y = 220$
9. $y = 4.25x + 550$	10. $y = 550x + 4.25$	11. $y = 800 + 60x$	12. $x + y = 1460$
13. $y = 0.25x + 35$	14. $y = 4.50x + 475$	15. $y = 35x + 0.25$	16. $5x + 8y = 1460$

4.1.2: What's My Equation? (Continued)

Problem A:

Yasser is renting a car. Zeno Car Rental charges $45 for the rental of the car and $0.10 per kilometre driven. Erdos Car Rental charges $35 for the rental of the same car and $0.25 per kilometre driven. Which company should Yasser choose to rent the car from?

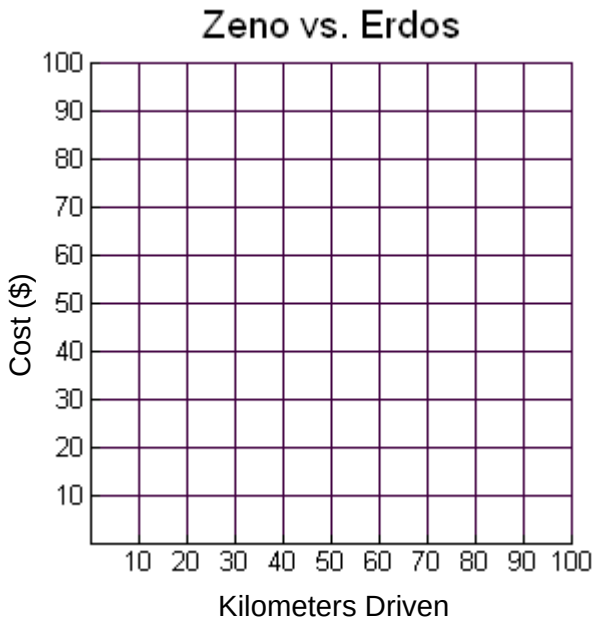
To solve the question, complete the table of values, and the graph.

Zeno

Distance (km)	Cost
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	

Erdos

Distance (km)	Cost
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	



1. How can the car rental cost and the cost per kilometre be used to draw the graph?

2. What is the point of intersection of the two lines? What does it represent?

3. Under what conditions is it best to rent from Zeno Car Rental?

4. Under what conditions is it best to rent from Erdos Car Rental?

4.1.2: What's My Equation? (Continued)

Problem B:

The school council is trying to determine where to hold the athletic banquet. The Algebra Ballroom charges an $800 flat fee and $60 per person. The Geometry Hall charges a $1000 flat fee and $55 per person.
Which location should the school council select for the athletic banquet?

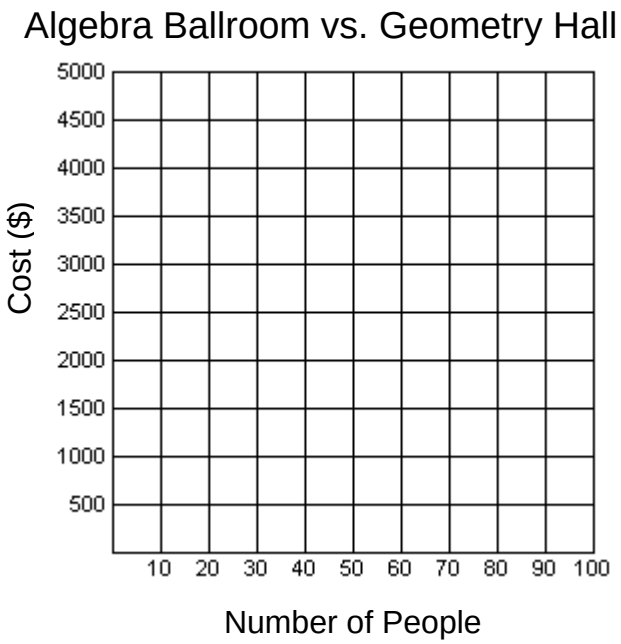
To solve the question, complete the table of values, and the graph.

Algebra Ballroom

Number of People	Cost
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	

Geometry Hall

Number of People	Cost
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	



1. How can the flat fee and the per person cost be used to draw the graph?

2. What is the point of intersection of the two lines? What does it represent?

3. Under what conditions is it best to go with Algebra Ballroom?

4. Under what conditions is it best to go with Geometry Hall?

4.1.2: What's My Equation? (Continued)

Problem C:

The yearbook club is considering two different companies to print the yearbook. The Descartes Publishing Company charges a flat fee of $475 plus $4.50 per book. School Memories charges a flat fee of $550 plus $4.25 per book. Which company should the yearbook club select to print this year's yearbook?

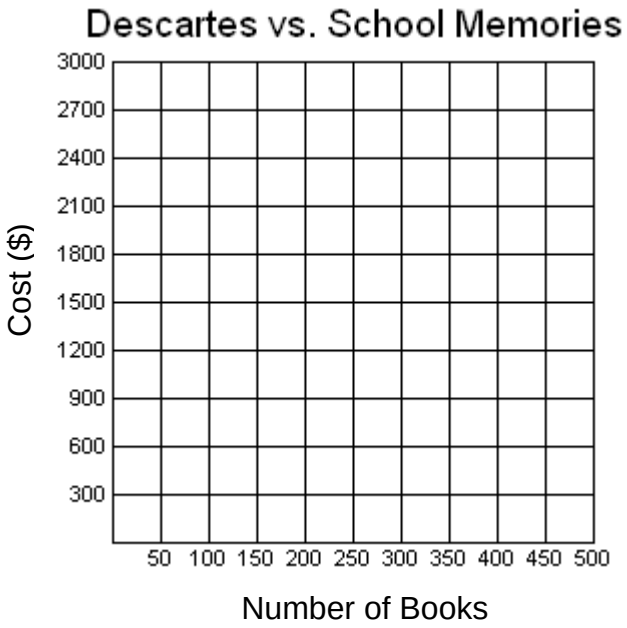
To solve the question complete the table of values, and the graph.

Descartes

Number of Books	Cost
0	
50	
100	
150	
200	
250	
300	
350	
400	
450	
500	

School Memories

Number of Books	Cost
0	
50	
100	
150	
200	
250	
300	
350	
400	
450	
500	



1. How can the flat fee and the cost per book be used to draw the graph?

2. What is the point of intersection of the two lines? What does it represent?

3. Under what conditions is it best to go with Descartes Publishing?

4. Under what conditions is it best to go with School Memories?

4.1.2: What's My Equation? (Continued)

Problem D:

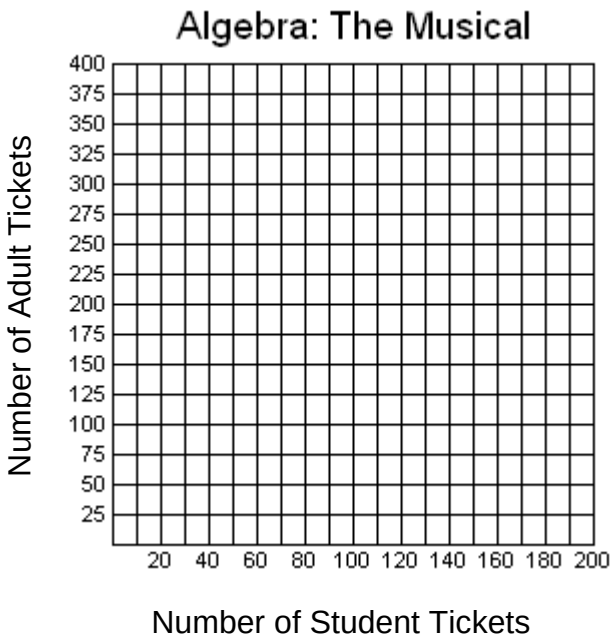
The school is putting on the play "Algebra: The Musical". Adult tickets were sold at a cost of $8 and student tickets were sold at a cost of $5. A total of 220 tickets were sold to the premiere and a total of $1460 was collected from ticket sales.
How many adult and student tickets were sold to the premiere of the musical?

To solve the question complete the table of values, and the graph.

Let *x* represent the # of student tickets sold
Let *y* represent the # of adult tickets sold

x	*y*
0	
40	
80	
120	
160	
200	

x	*y*
0	
40	
80	
120	
160	
200	



1. What is the approximate point of intersection of the two lines? What does it represent?

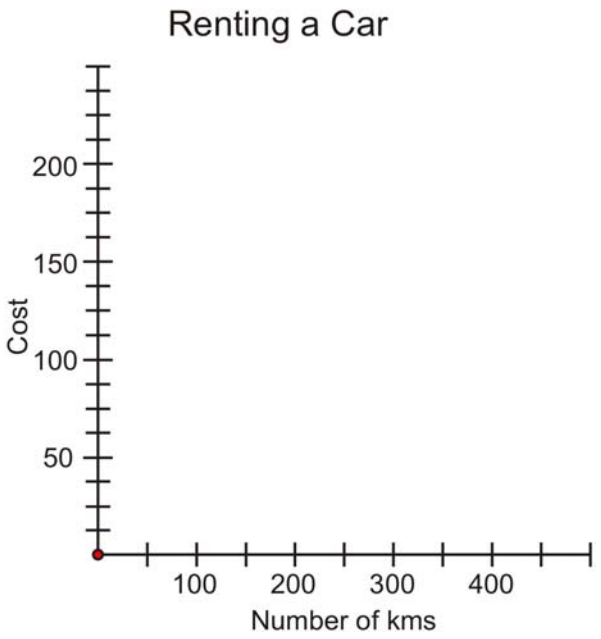
2. Does the rest of the graph (other than the POI) give us any information about the number of tickets sold?

4.1.3: Meaning of the Point of Intersection

1. Your family wants to rent a car for a weekend trip. **Cars R Us** charges $60.00 per weekend for a midsize car plus $0.20 per km. **Travel With Us** charges $0.50 per km.

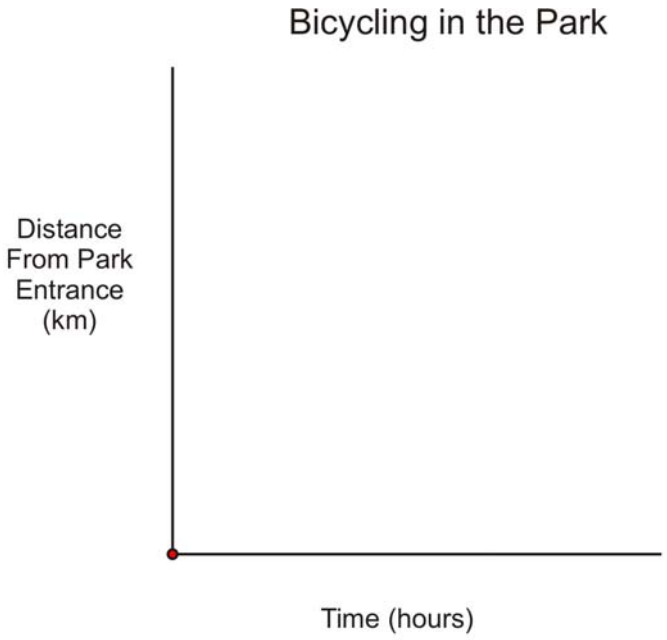
   a. Graph both options on the grid and determine the number of kilometres where both companies will cost the same amount.

   b. Explain what this means for your weekend trip.



2. Anthony and Anne are bicycling at a Provincial Park. Anthony travels at the rate of 10 km/hr and begins 2 km from the park entrance. Anne begins at the park entrance and travels at a rate of 15 km/hr. They both travel at a constant rate towards the Outdoor Education Centre.

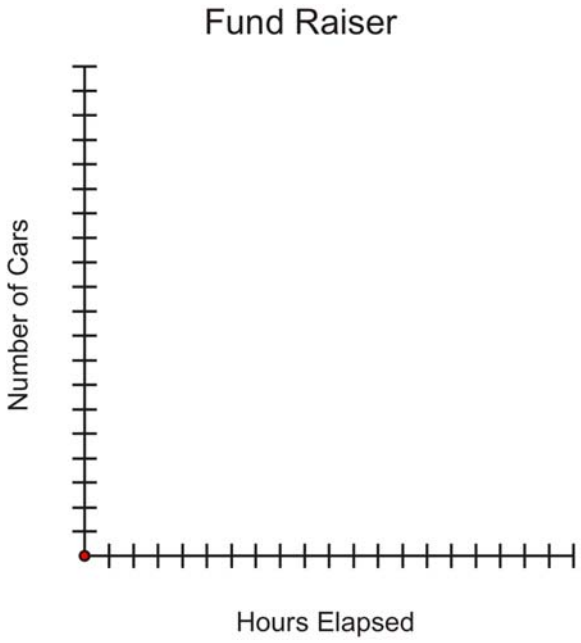
   Graph both routes on the grid and determine the meaning of the point of intersection.



4.1.3: Meaning of the Point of Intersection (Continued)

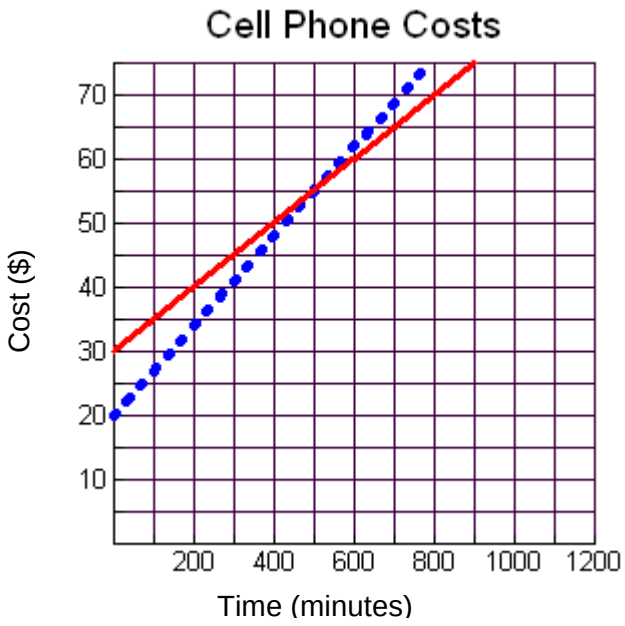
3. For a car wash fundraiser **Team A** washes 2 cars per hour starting a 7:00 a.m. **Team B** begins washing cars at 9:00 a.m. and washes 3 cars per hour.

   Graph the car washing progress of each team on the grid and determine the meaning of the point of intersection, as well as the meaning of the points before and after the point of intersection.



4.2.1: A Visual Cell Phone Problem

Two cell phone companies charge a monthly flat fee plus an additional cost for each minute of time used. The graph below shows the Time vs. Cost relationship, for one month.



1. What is the Point of Intersection (POI), and what is the meaning of the POI in relation to the cell phone plans?

2. Under what conditions is it best to use the Talk More cell phone plan?

3. Under what conditions is it best to use the We Talk cell phone plan?

4. How does the graph help you to determine which cell phone plan is the most appropriate at any given time?

4.2.2: Music is My Best Friend

iTones and Music Mine are two online music providers. Each company charges a monthly membership fee and then a per song download rate.

iTones charges \$10 per month, and \$1 per song $C = n + 10$
Music Mine charges \$7 per month and \$1.50 per song. $C = 1.5n + 7$

Where C represents the total cost for one month and *n* represents the number of songs purchased.

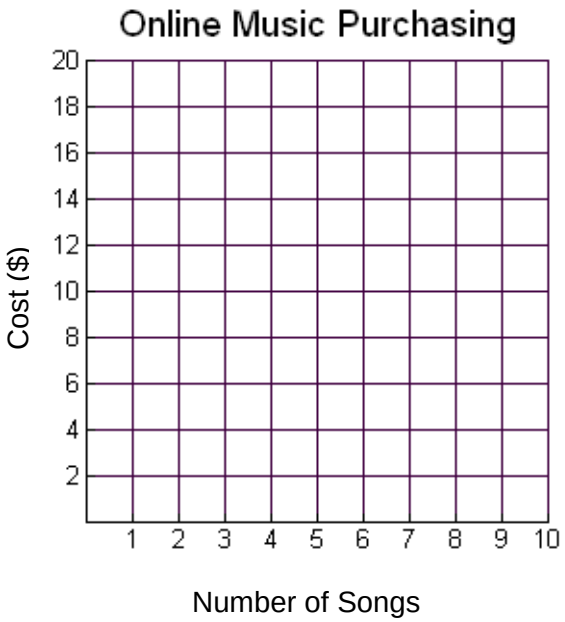
Create a table of values showing the total charges for up to 8 songs purchased.
Graph the lines on the same graph below.

iTones

N	*C*
0	
1	

Music Mine

n	*C*
0	
1	



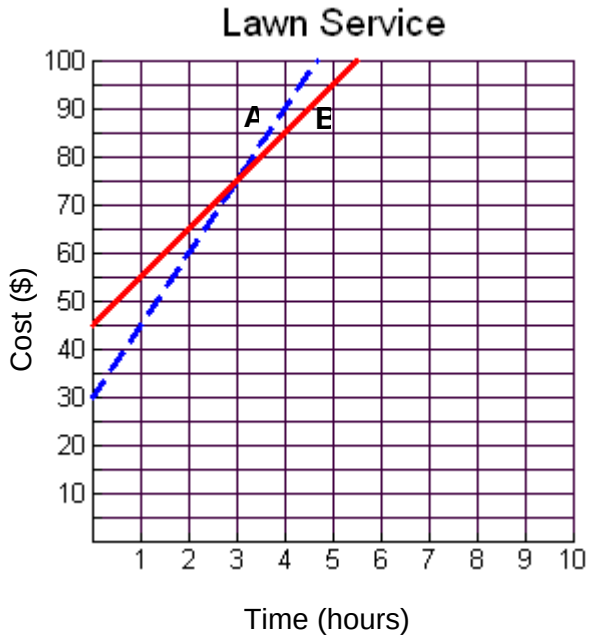
1. If Lulu plans to purchase 7 songs this month, which is the best plan for her? Explain.

2. Which plan is cheaper if you only plan to buy 4 songs per month? How do you know from the graph?

3. Which cell phone plan would you choose and why? Relate your answer back to the POI.

4.2.3: Where Do We Meet?

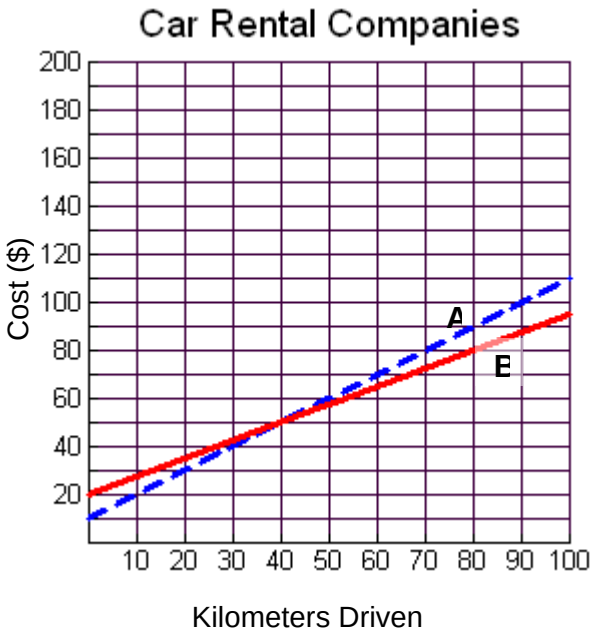
For each of the following situations, find the point of intersection and describe the meaning of this point. Describe which company or service you would choose under what circumstances. A template has been provided for the first situations.



Point of intersection:_____

Interpretation of the point:

If the job lasts less than _____ hours, choose _____. If the job lasts more than _____ hours, choose _____. If the job lasts _____ hours, choose either company and the cost is_____



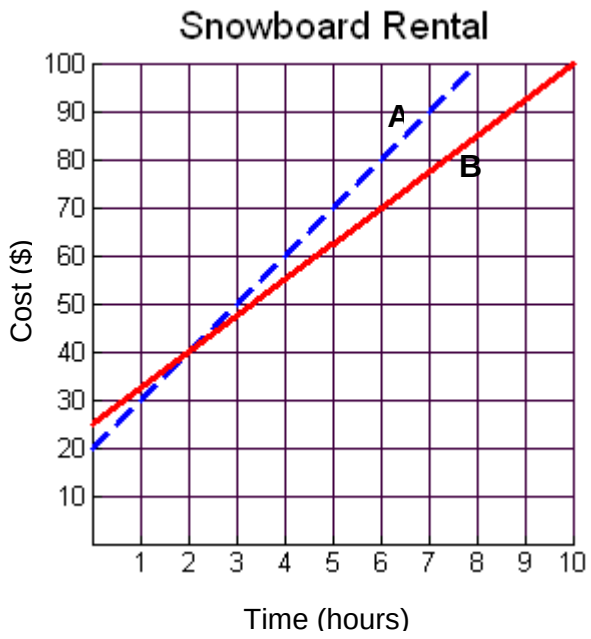
Point of intersection:_____

Interpretation of the point:

If the kilometers driven is less than _____, choose _____. If the kilometers driven is more than _____, choose _____. If the kilometers driven is _____, choose either company and the cost is_____

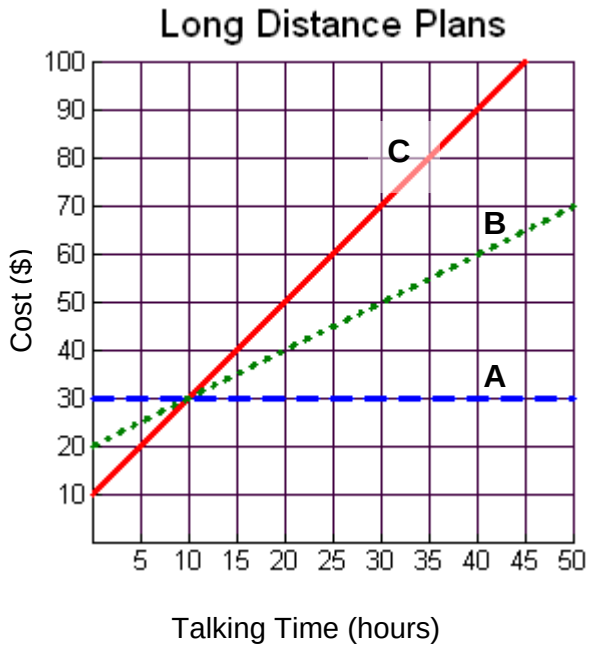
4.2.3: Where Do We Meet? (Continued)

For each of the following situations, find the point of intersection and describe the meaning of this point. Refer back to the template provided for the first situations.



Point of intersection:_____

Interpretation of the point:



Point of intersection:_____

Interpretation of the point:

4.2.4: Does This Line Cross?

From the list of relations below, determine which lines cross through the point (2,3).
You may use the graph to assist you.

1. $y = 2x + 3$

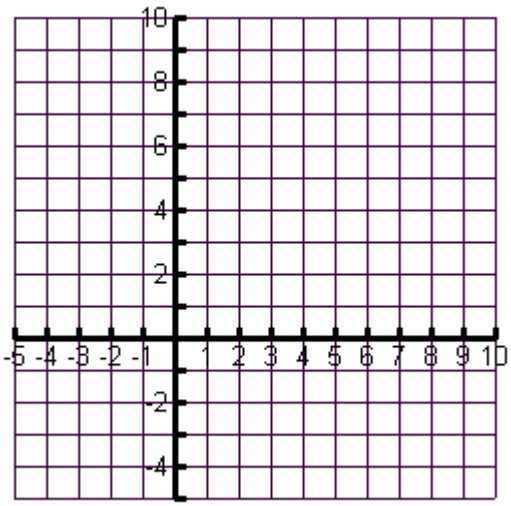
2. $y = x + 1$

3. $y = -2x + 7$

4. $y = -3$

5. $x = 2$

6. $y = 2$



Questions:

1. Which of the lines passes through the point (2,3)?

2. Is there another way to determine if the line passes through the point, other than graphing? Explain.

3. Without graphing, how can you quickly determine if a horizontal or vertical line passes through a point?

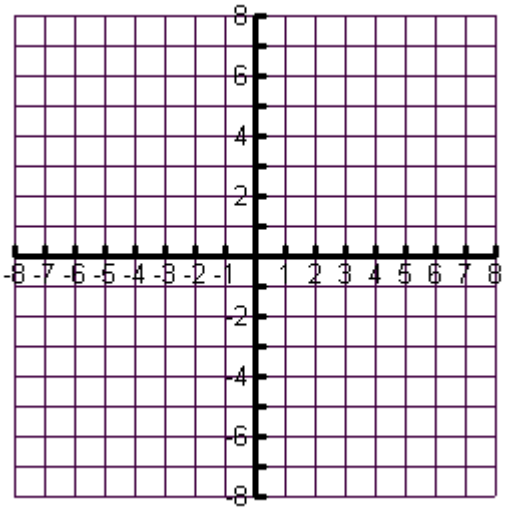
4. Other than the point (2, 3), what are the other points of intersection on your graph?

5. Is it possible for two lines to have more than one point of intersection **with each other**? Discuss this with your partner.

4.2.5: Is this Accurate?

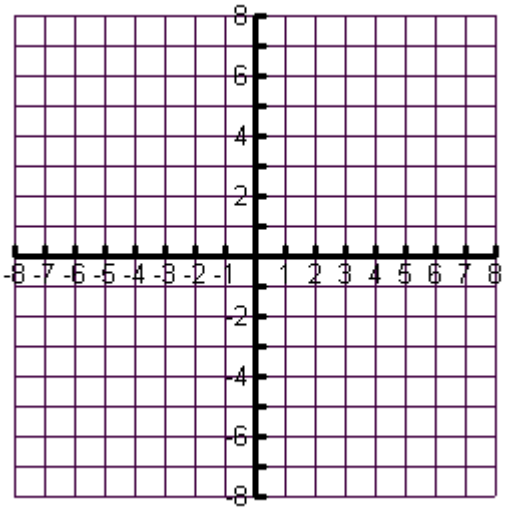
1. Find the point of intersection. (Solve the system using **graphical method**.)

a) $y = 2x + 1$
$y = 3x – 2$



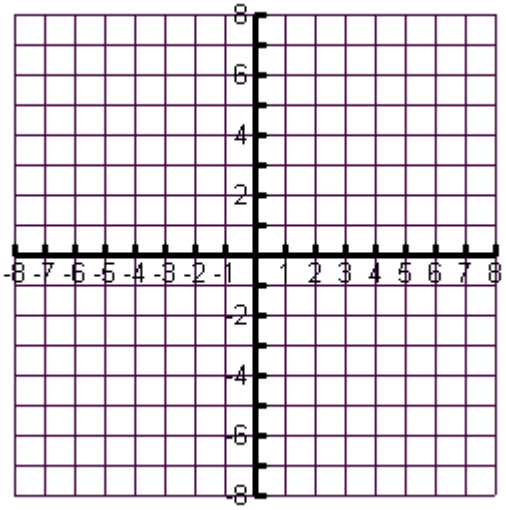
Point of intersection is :_____

b) $y = -x -2$
$y = 2x + 7$



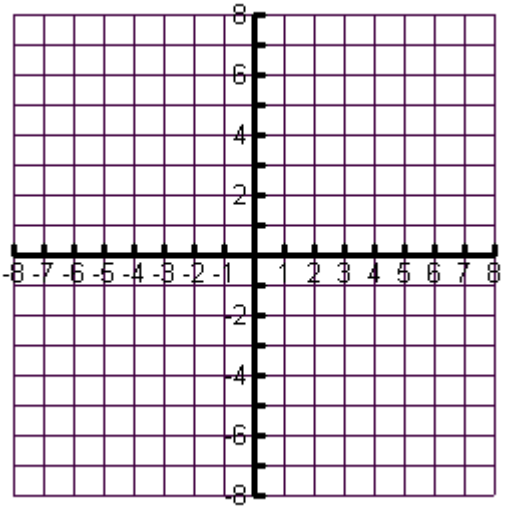
Point of intersection is:_____

c) $y = 2x + 1$
$y = 4x – 4$



Point of intersection is :_____

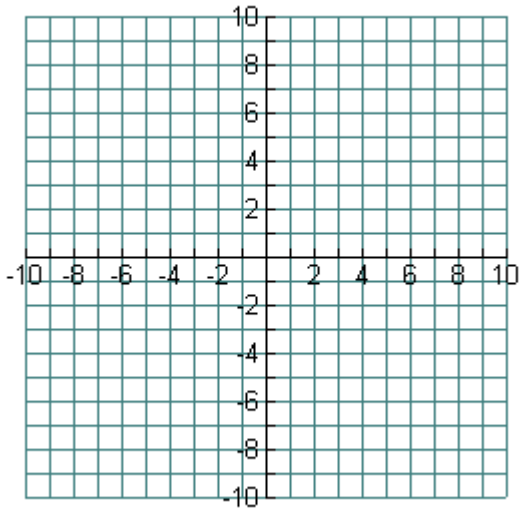
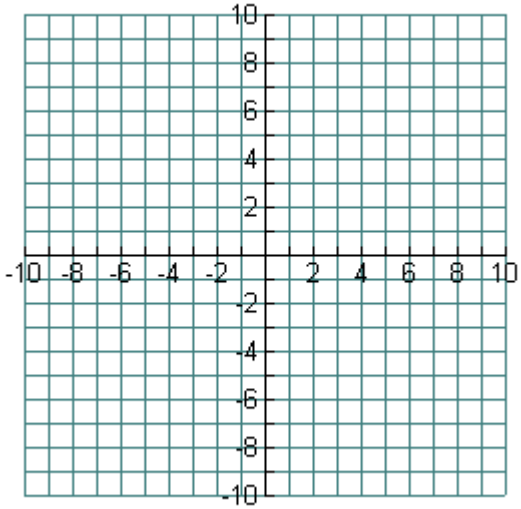
d) $y = -5$
$y = -3x+2$



Point of intersection is :_____

4.3.1: What's my POI?

- Each one of you will **solve** one of the systems of equations given below.
- Once you have solved the system you were assigned, **trade** with your partner and **check** their solution. **Share** your feedback with your partner.
- Once you have shared your feedback and are confident in the solutions to the systems, **post** your point of intersection under the appropriate heading on the class list.

System A	System B
$y = \frac{1}{2}x - 1$ $y = -3x + 4$	$y = 2x + 7$ $y = -3x + 4$
	
Point of Intersection: (,)	Point of Intersection: (,)

4.3.2: A Better Way

Solve the following systems of equations **algebraically**. Use your CAS handheld to solve and check if needed.

1. Equation 1: $y + 2 = 10$ and Equation 2: $x + y = 12$

Point of intersection: (____, ____)

2. Equation 1: $3x + 2y = 33$ and Equation 2: $2x = x + 7$

Point of intersection: (____, ____)

In each of the systems you solved above, which equation did you choose to solve first? Why did you select that equation in each case?

4.3.3: Putting the Pieces Together

System 1: $y = 2x + 7$ and $y = -3x + 4$

Record the line that results once you have substituted, and then solve the equation using your CAS handheld.

Resulting equation and my solution. (Don't forget to solve for both variables.)	
Check your solution using the CAS handheld.	
Compare your solution to someone else in the class.	

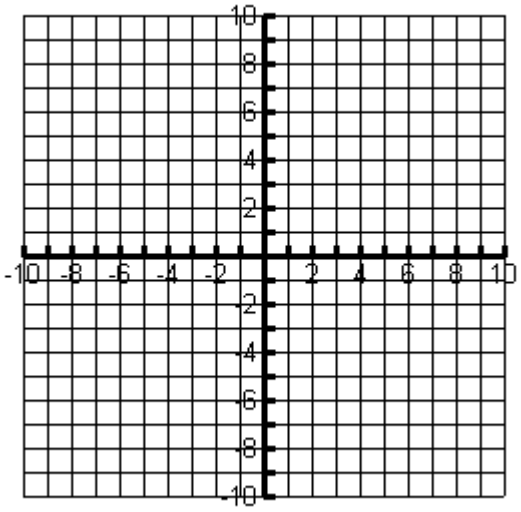
System 2: $-2x + y = 0$ and $x - y = 12$

Record the line that results once you have substituted, and then solve the equation using your CAS handheld.

Resulting equation and my solution. (Don't forget to solve for both variables.)	
Check your solution using the CAS handheld.	
Compare your solution to someone else in the class.	

4.3.4: The "Sub" Way

- In groups of three, have each person in the group solve one of the systems below.
- Use your CAS handheld to help you solve and check your system.
- Share your solutions with each person in the group.

System A	System B
$y = 4x + 24$ and $y = -5x - 12$	$13x + y = -4$ and $5x + y + 4 = 0$
System C	**Challenge**
$y = -x - 8$ and $y = -5x$	**CHALLENGE**: Plot each of the POI's from Systems A, B, and C and find the equation of the line that connects the three points.  Equation of Line:_____

4.3.5: What's My Equation? - Part 2

Part A
Let's return to our application problems that we solved graphically earlier in the unit. Assign each person in your group one of the three problems to solve. Solve these application problems using the method of substitution introduced today. Use the CAS handheld to help you solve.

Problem A:

Yasser is renting a car. Zeno Car Rental charges $45 for the rental of the car and $0.15 per kilometre driven. Erdos Car Rental charges $35 for the rental of the same car and $0.25 per kilometre driven. For what distance do the two rental companies charge the same amount?

Equations

y = 45 + 0.15x

y = 35 + 0.25x

Problem B:

The school council is trying to determine where to hold the athletic banquet. The Algebra Ballroom charges an $800 flat fee and $60 per person. The Geometry Hall charges a $1000 flat fee and $55 per person. For what amount of guests do the two banquet halls charge the same amount?

Equations

y = 60x + 800

y = 55x + 1000

Problem C:

The yearbook club is considering two different companies to print the yearbook. The Descartes Publishing Company charges a flat fee of $475 plus $4.50 per book. School Memories charges a flat fee of $550 plus $4.25 per book. For what amount of books do the two companies charge the same amount?

Equations

y = 475 + 4.50x

y = 550 + 4.25x

I am solving problem ___:

4.3.5: What's My Equation? - Part 2 (Continued)

Part B
Discuss the following questions with your group members.

1. Looking at your problem, how can you tell from the equation which company is cheaper before the point of intersection (where the costs are equal)?

2. Looking at your problem, how can you tell from the equation which company is cheaper after the point of intersection (where the costs are equal)?

3. Is this true for all problems?

4. Now that you've solved the problems using two different methods, which method do you prefer? Why?

5. When do you think solving by substitution would be preferable to solving by graphing?

4.4.1: The Lowdown on Downloads

Let's return to our music downloading problem. Here's the problem again.

iTones and Music Mine are two online music providers. Each company charges a monthly membership fee and then a per song download rate.

iTones charges \$10 per month, and \$1 per song	$C = x + 10$
Music Mine charges \$7 per month and \$1.50 per song.	$C = 1.5x + 7$

1. Find the number of songs that I would need to download where the costs are the same for the two music providers.

2. Paris solved the problem and then made the following conclusion:

> *If you download less than 6 songs per month than choose iTones since the cost per song is less. If you download more than 6 songs per month than choose Music Mine since the fixed cost is less. If you download exactly 6 songs per month, choose either*

Is the conclusion that Paris made correct? If not, underline the part(s) of her conclusion that are incorrect and then rewrite it so that it is correct.

4.4.2: Putting the Pieces Together (Continued)

Solve the system: $y = 10 - 2x$ and $x - 2y = 10$

The steps to the solution to this system are given in the pieces below. Cut the pieces out and glue them in the correct order on a separate piece of paper. Use the handheld to help you. **Hint: There are 10 steps in the complete solution.**

✂

$x - 2(10 - 2x) = 10$	$-x = 20$
$x = 6$	Point of Intersection: (6,-2)
$x - 20 - 4x = 10$	$y = 10 - 12$
$y = 14$	$x - 10 - 2x = 10$
$y = -2$	$y = 10 - 2(6)$
$5x = 10 + 20$	$x = 30/5$
$-x = 10 + 10$	$5x = 30$
$x = -20$	$x - 20 + 4x = 10$
$x = -2$	Point of Intersection: (-2,6)

4.4.3: An Interesting Problem

Consider the following three systems of equations:

System A	System B	System C
$x + 2y = 3$ and $4x + 5y = 6$	$-2x + y = 4$ and $7x + 10y = 13$	$-5x - 3y = -1$ and $x + 3y = 5$

1. In order to solve these systems by substitution, we need to first **isolate one variable in one equation**. Circle the variable in each system that would require just **one** step to isolate. Compare your choice with a neighbour.

2. Using your handheld to help you, isolate the variable you selected in #1 for each system.

System A	System B	System C

3. Assign each system to one person in your group and solve the system assigned to you in the space below. Use your handheld to help solve and check.

I am solving system _____:

Point of Intersection (_____, _____)

4. Compare your solution to the rest of the group. What do you notice?

4.4.3: An Interesting Problem (Continued)

5. The chart below lists out only the numbers that appear in each system. What do you notice about the numbers in each system?

System A	System B	System C
1, 2, 3, 4, 5, 6	*-2, 1, 4, 7, 10, 13*	*-5, -3, -1, 1, 3 , 5*

6. Let's see if this works with more systems. Each system below has only one equation given. Assign each system to one person in the group and create a second equation that will give the solution (-1, 2) when solved.

System A	System B	System C
Equation 1: x + 6y = 11 *Equation 2: _____*	*Equation 1: -14x – 9y = -4* *Equation 2: _____*	*Equation 1: 9x + 7y = 5* *Equation 2: _____*

7. Share your equation with everyone in the group and copy down the equations from the rest of the group. Review the equations created and make sure they follow the rule that you noted in #5. You will solve these three systems as a part of your home activity.

4.4.4: The Sub Steps

Solving using the method of substitution requires five steps. The steps are given below in the text boxes. Discuss with your partner what you think the correct order is for the steps and then write the steps in the space provided. Solve the system in the chart as model of solving by substitution. Check using your handheld.

State the point of intersection.

Solve the resulting equation.

Substitute the isolated expression into the other equation.

Substitute your solution into an original equation to solve for the other variable.

Isolate for a variable. The easiest variable to isolate for has a coefficient of 1.

Steps for Solving by Substitution	Example: Solve $4x + y = 6$ and $2x - 3y = 10$

4.5.1: A Trip to Jim Hortons

It's summer vacation. Ah, sweet freedom. The only problem is that you're the designated coffee gopher at the office where you have a summer job. On Monday, you were sent out to Jimmies to pick up five small coffees and seven extra large coffees. You remember that the total cost was $14.95, including tax. On Tuesday, you were sent out to get three small coffees and seven medium coffees. You recall that the total came to $12.75, with tax.

It's Wednesday morning and your coffee crazy co-workers are calling for their cup o' joe. Unfortunately, since the morning fix hasn't arrived yet, no one can remember how much a small or extra large coffee costs, including yourself. You need to find out how much each size costs to collect the correct amount of money for the Wednesday coffee run.

1. Let s be the number of small coffees ordered on a single day.

   Let e be the number of extra large coffees ordered on a single day.

   As a class, can we decide on an equation to represent the purchases made on Monday, and an equation to represent the purchases made on Tuesday?

   Monday's equation: _____

   Tuesday's equation: _____

2. Now we have a linear system. Take a few minutes to solve the linear system using substitution in the space below. Then pair with another student to discuss your solution.

3. What problems, if any, did you encounter?

4.5.2: An Elimination Introduction

You know that two integers can be added, or subtracted:

$$\begin{array}{r} 5 \\ +\ 7 \\ \hline 12 \end{array} \qquad\qquad \begin{array}{r} 15 \\ -\ 6 \\ \hline 9 \end{array}$$

In the same way, equations can be added, or subtracted:

$$+\ \begin{array}{l} 3x + 2y = 19 \\ 5x - 2y = 5 \\ \hline 8x = 24 \end{array} \qquad\qquad -\ \begin{array}{l} 10x + 20y = 80 \\ 10x + 15y = 25 \\ \hline 5y = 55 \end{array}$$

Notice that by adding the equations in the first linear system, the y variable was eliminated (there were 0y), which makes it possible to solve for x.

By subtracting the equations in the second linear system, the x variable was eliminated (there were 0x), which makes it possible to solve for y.

1. Work in pairs to consider the following linear systems. Decide what operation – addition or subtraction – would result in the elimination of a variable. You may use CAS on the handheld to help you decide.

$$\begin{array}{l} 9x + y = 4 \\ 14x + y = -1 \end{array} \qquad \begin{array}{l} 3x - y = 50 \\ 12x + y = 115 \end{array} \qquad \begin{array}{l} -7x - 6y = 338 \\ 9x + 6y = -366 \end{array}$$

$$\begin{array}{l} 18x - 5y = 454 \\ 12x - 5y = 316 \end{array} \qquad \begin{array}{l} 19x + 2y = 102 \\ 19x - 2y = 50 \end{array} \qquad \begin{array}{l} 17x - 8y = 323 \\ 6x + 8y = 114 \end{array}$$

$$\begin{array}{l} 9x - 4y = 235 \\ 15x + 2y = 409 \end{array} \qquad \begin{array}{l} 7x - 16y = 441 \\ 7x - 17y = 476 \end{array} \qquad \begin{array}{l} 5x - 3y = 188 \\ 6x - 11y = 344 \end{array}$$

2. What needs to be true about a linear system so that a variable is eliminated when the equations are added or subtracted?

4.5.3: Solving a Linear System by Elimination

1. How would you begin solving this linear system? Addition or Subtraction?

$$5x + 4y = 7$$
$$3x - 4y = 17$$

2. Solve the system.

3. In your own words, describe what you must do to solve a linear system by elimination.

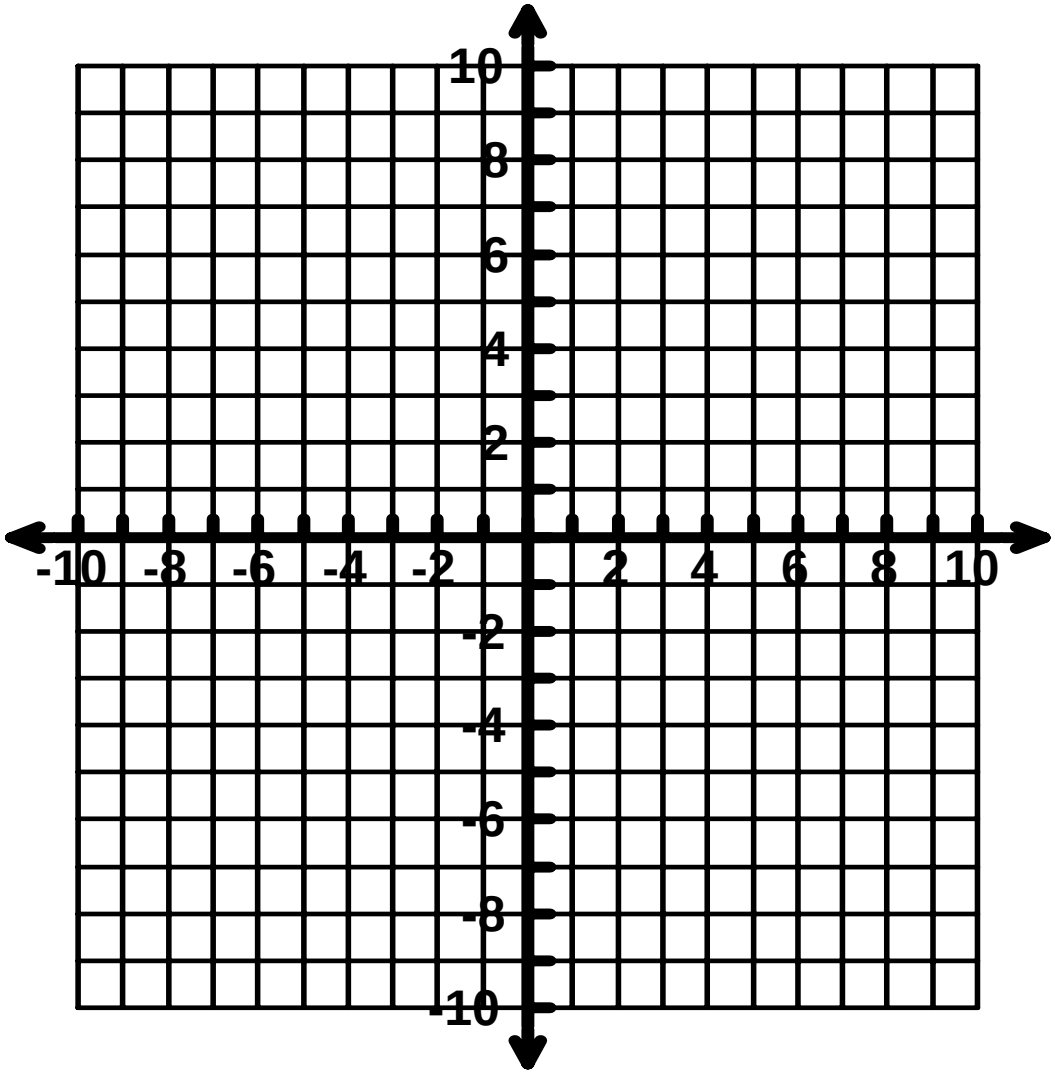
4.6.1: What's the difference?

Original equation: $x + 2y = 6$

Multiply the equation by the constant _____. The new equation is _____.

Complete the table of values for your equation and plot the values on the grid provided.

x	-4	-2	0	2	4
y					



4.6.2: Elimination Preparation

1. Consider the following linear system:

$$\begin{aligned} 3k + 15m &= 15 \\ -k - m &= -1 \end{aligned}$$

   If you add or subtract the equations, will a variable be eliminated? Explain.

2. What could be done to create the conditions necessary for elimination?

4.6.3: Algebra, the Musical - Redux

Recall that in the first lesson of this unit, you solved the following problem by graphing:

> The school is putting on the play "Algebra: The Musical". Adult tickets were sold at a cost of $8 and student tickets were sold at a cost of $5. A total of 220 tickets were sold to the premiere and a total of $1460 was collected from ticket sales. How many adult and student tickets were sold to the premiere of the musical?

If x represents the number of student tickets sold, and y represents the number of adult tickets sold, then the equations that model this problem are:

(from cost of tickets) $5x + 8y = 1460$

(from number of tickets sold) $x + y = 220$

You probably remember that this problem took a while to solve by graphing, and the answer you found was not necessarily very accurate, since you read the point of intersection off of the graph.

You will work with a partner now to solve this problem using the method of elimination.

1. Since you have been asked to eliminate the *x or y variable* **(circle one)** first, what will be the first step you take to create the conditions necessary for elimination?

2. Solve the linear system now. You may use CAS to help find the answer and check the solution. Use the space below for rough work.

3. Does it matter which variable is eliminated first? That is, does it change the final answer?

4. Think back to when you solved this problem by graphing. Do you find the method of elimination easier or harder? Explain.

4.6.4: Two for You

Try solving the following questions using the method of elimination. You may use CAS on the handhelds to help solve the questions and check your solutions.

1. A fitness club charges an annual fee and an hourly fee. In a single year, member A worked out for 76 hours and paid $277 in total. Member B worked out for 49 hours and paid $223 in total. What is the annual fee? What is the hourly fee?

   HINT: Start by writing "let" statements to define the variables you will use. For example:

   Let ***a*** represent the amount of the annual fee.
   Let ***h*** represent the amount of the hourly fee.

2. This past summer, you ran a food booth at a local festival. You sold hotdogs for $1 each and samosas for $2.50 each. From 205 purchases, you made $400 in total. To help plan purchases for next year's festival, you'd like to know how many hotdogs and samosas were sold. Unfortunately, you forgot to keep track of this when selling the food. Can you determine how many hotdogs and samosas were sold?

   NOTE: Assume one hotdog **or** one samosa per purchase.

4.6.5: Help an Absent Friend

Consider the following linear system:

$$2x + 3y = 1$$
$$3x - y = 7$$

How would you solve it? Write in words a description of the steps you would take.

To help you understand what to write, pretend for a moment that you are writing the instructions for a friend who is not in class today. What steps would you need to describe?

4.6.6: “Here’s To The Crazy Ones”

1. Solve the following linear system by elimination:

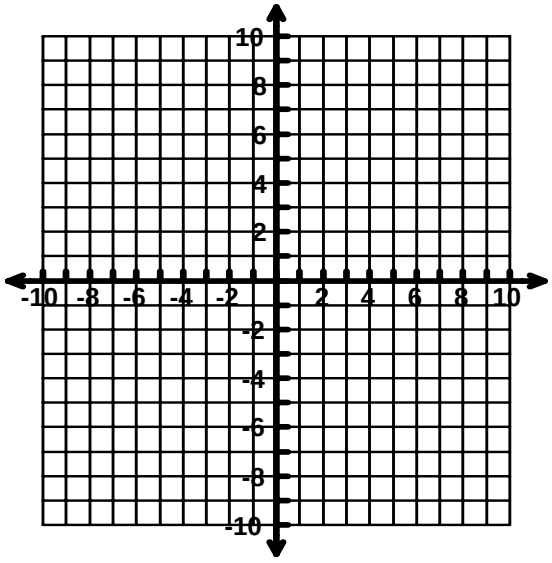
$$4x + 2y = 12$$
$$8x + 4y = 32$$

2. Did you encounter any results that are unusual? Explain what is different compared to questions you have already solved.

3. Re-arrange each equation from the linear system into $y = mx + b$ form, then graph.

For example, here is how the first equation can be re-arranged:

$$4x + 2y = 12$$
$$2y = -4x + 12$$
$$\frac{2y}{2} = \frac{-4x}{2} + \frac{12}{2}$$
$$y = -2x + 6$$



4. What do you notice about the slope in each equation that you re-arranged? What do you notice about how the two lines visually relate to each other? Is there a solution to this linear system?

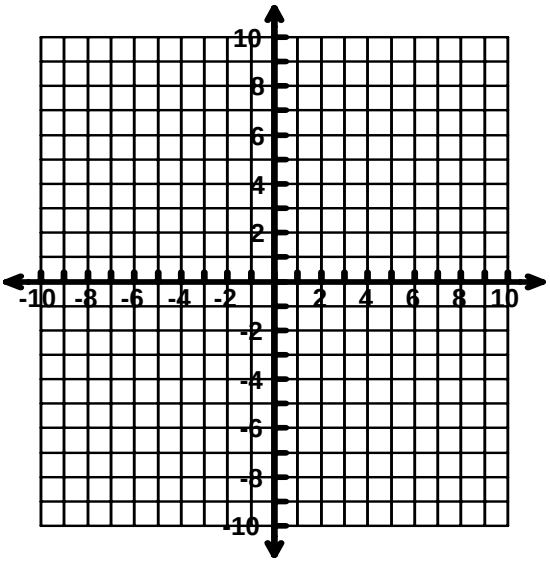
4.6.6: "Here's To The Crazy Ones" (Continued)

5. Solve the following linear system by elimination:

$$6x + 2y = 2$$
$$12x + 4y = 4$$

6. Did you encounter any results that are unusual? Explain what is different compared to questions you have already solved.

7. Re-arrange each equation from the linear system into $y = mx + b$ form, then graph.

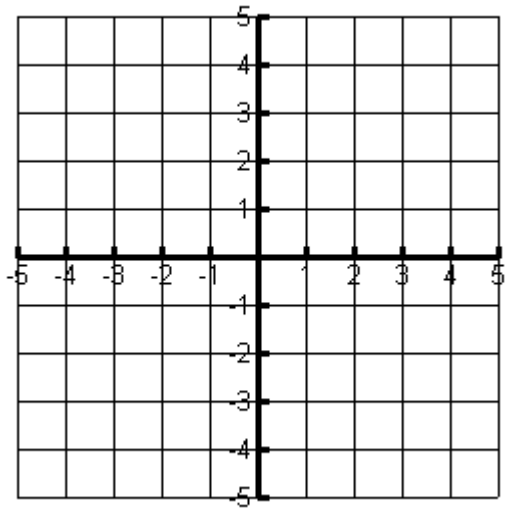


8. What do you notice about the slope and y-intercept in each equation that you re-arranged? What do you notice about how the two lines visually relate to each other? Is there a solution to this linear system? If so, how many?

4.7.3: Which Method?

<table>
<tr>
<td>For System A determine if you can solve the system using each of the three methods you have learned, and if you can, then solve.

$2x + 3y = 10$
$-4x + 5y = 2$

Justify why you can or cannot solve using this method.</td>
<td>Graphing:
 

Justification:</td>
</tr>
<tr>
<td>Substitution:

Justification:</td>
<td>Elimination:

Justification:</td>
</tr>
</table>

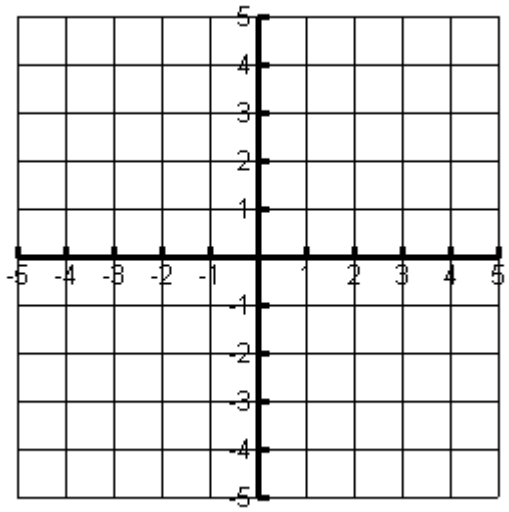
4.7.3: Which Method? (Continued)

<table>
<tr>
<td>For System B determine if you can solve the system using each of the three methods you have learned, and if you can, then solve.

$y = x - 2$

$x + 5y = -4$

Justify why you can or cannot solve using this method.</td>
<td>Graphing:

Justification:</td>
</tr>
<tr>
<td>Substitution:

Justification:</td>
<td>Elimination:

Justification:</td>
</tr>
</table>

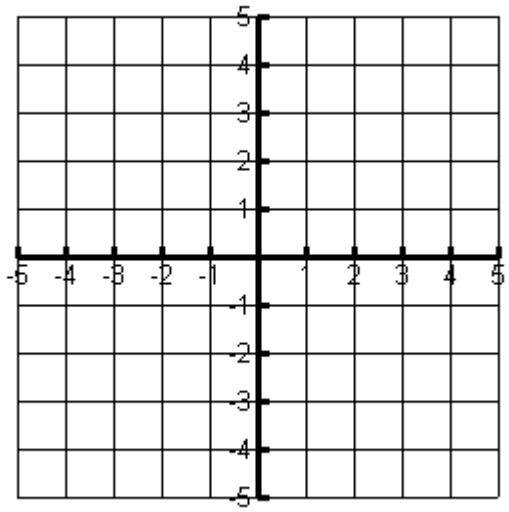
4.7.3: Which Method? (Continued)

<table>
<tr>
<td>For System C determine if you can solve the system using each of the three methods you have learned, and if you can, then solve.

$y = 2x - 7$

$y = -4x + 5$

Justify why you can or cannot solve using this method.</td>
<td>Graphing:

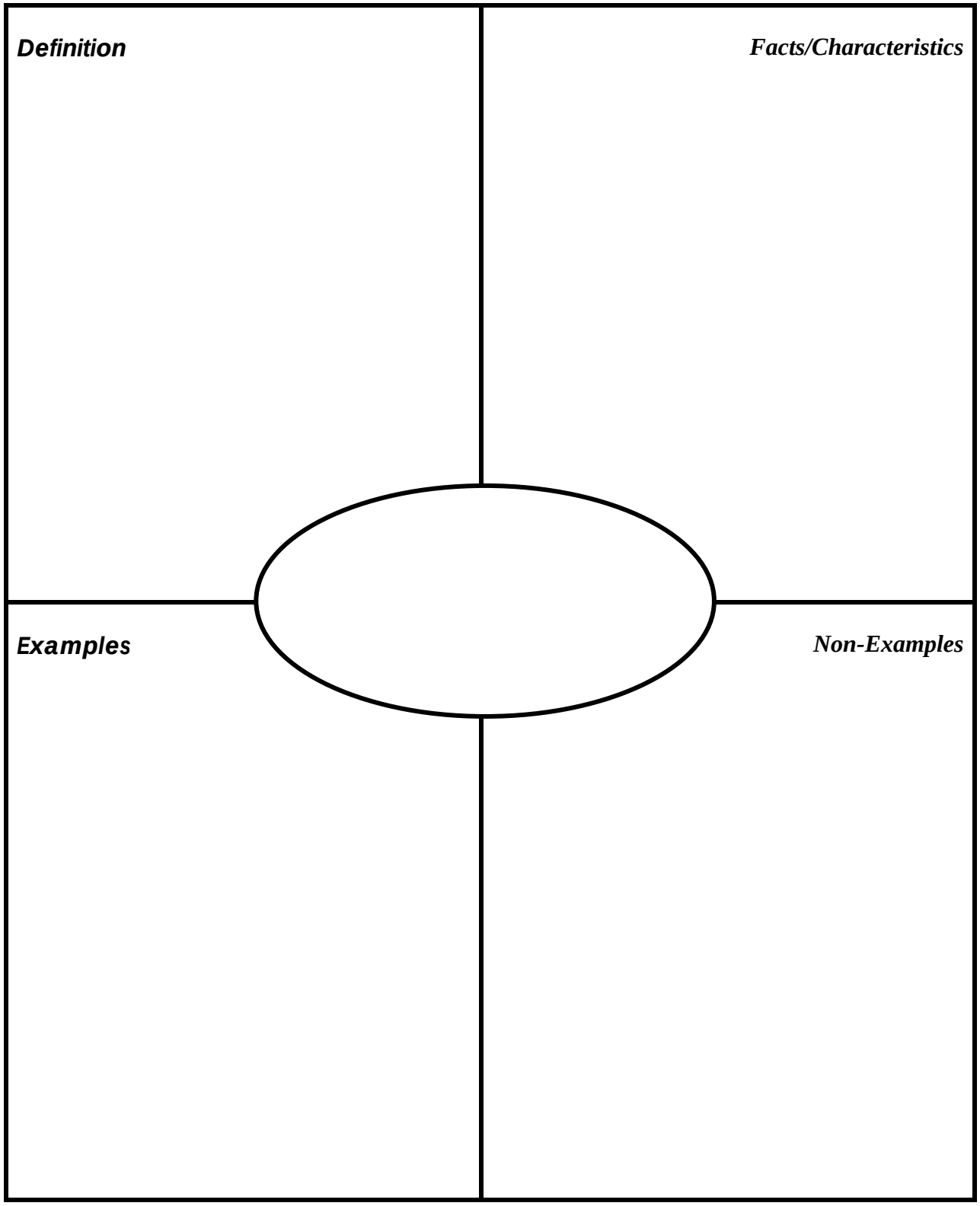
 

Justification:</td>
</tr>
<tr>
<td>Substitution:

Justification:</td>
<td>Elimination:

Justification:</td>
</tr>
</table>

4.7.4: The Frayer Model



4.7.5: 3 Ways

Two catering companies provide food and the banquet hall for weddings, proms and anniversaries. Nick and Heather are getting married in September and they have two catering companies to choose from:

Cookie's Catering	**Frugal Gourmet**
Cesaer Salad	Minestrone Soup
Chicken Picatta	Mixed green salad
Roasted Potatoes	Prime Rib
Steamed Vegetables	Garlic Mashed Potatoes
Sherbert	Asparagus
Coffee or Tea	Apple Pie
	Coffee or Tea

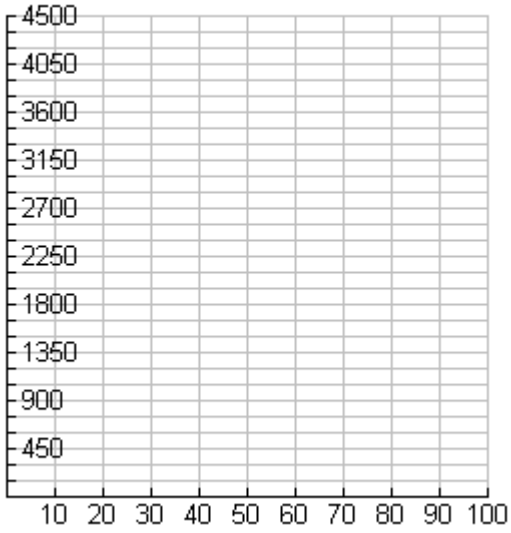
The cost(C) for the different menu options includes the cost of the hall rental and price per person(n).

Cookie's Catering: C= 40n+500

Frugal Gourmet: C=45n+350

Cookie's Catering		**Frugal Gourmet**	

Solve the system using the graphing method:



Point of intersection:_____

4.7.5: 3 Ways (Continued)

Solve the system using substitution Point of intersection:_____	Solve the system using elimination Point of intersection:_____
What does the point of intersection mean in this catering problem?	You used 3 different methods to solve the system, what did you notice about the points of intersection? Does this surprise you?
Nick and Heather have invited 80 people to their wedding. How much will it cost for each menu?	Heather prefers the Frugal Gourmet menu to Cookie's Catering. How much more will she pay for her preference?

4.7.5: 3 Ways (Continued)

The student council is providing lunch and music for the grade 10 class. They have two quotes from Lunch Express and Let's Do Lunch. The costs for each were given as follow:
Lunch Express: If 100 students attend, it will cost $1 000. If 200 students attend, it will cost $1 500.

Let's Do Lunch: If 50 students attend, it will cost $700. If 150 students attend, it will cost $1 350.

Solve the system using the three different methods.

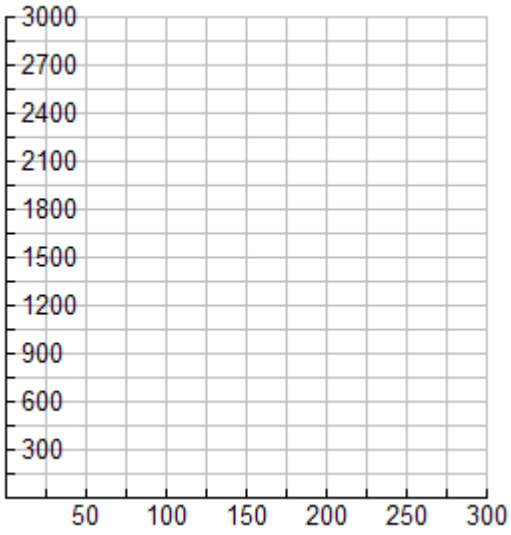
Equations for the companies:

Lunch Express:_____ **Let's Do Lunch**:_____

Lunch Express

Let's Do Lunch

Graphing Method



Point of intersection:_____

Substitution Method

Point of intersection:_____

4.7.5: 3 Ways (Continued)

Elimination Method Point of intersection:_____	The student council has $1 800 in their budget for the lunch. They prefer **Let's Do Lunch**, what is the greatest number of grade 10 students they can have at the lunch?
What does the ordered pair (25,750) mean on the **Lunch Express** line?	

4.S: Unit Summary Page

Unit Name: _____

Using a graphic organizer of your choice create a unit summary.

4.R: Reflecting on My Learning (3, 2, 1)

3 Things I know well from this unit
2 Things I need explained more
1 Question I still have

4.RLS: Reflecting on Learning Skills

Students should be aware of the importance that these skills have on your performance. After receiving your marked assessment, answer the following questions. Be honest with yourself. Good Learning Skills will help you now, in other courses and in the future.

- E – Always
- G – Sometimes
- S – Need Improvement
- N – Never

Organization

- E G S N I came prepared for class with all materials
- E G S N My work is submitted on time
- E G S N I keep my notebook organized.

Work Habits

- E G S N I attempt all of my homework
- E G S N I use my class time efficiently
- E G S N I limit my talking to the math topic on hand
- E G S N I am on time
- E G S N If I am away, I ask someone what I missed,
- E G S N I complete the work from the day that I missed.

Team Work

- E G S N I am an active participant in pairs/group work
- E G S N I co-operate with others within my group
- E G S N I respect the opinions of others

Initiative

- E G S N I participate in class discussion/lessons
- E G S N When I have difficulty I seek extra help
- E G S N After I resolve my difficulties, I reattempt the problem
- E G S N I review the daily lesson/ideas/concepts

Works Independently

- E G S N I attempt the work on my own
- E G S N I try before seeking help
- E G S N If I have difficulties I ask others but I stay on task
- E G S N I am committed to tasks at hand

Yes No I know all the different ways available in my school, where I can seek extra help.

Yes No I tried my best.

What will I do differently in the next unit to improve?

_____

_____

_____